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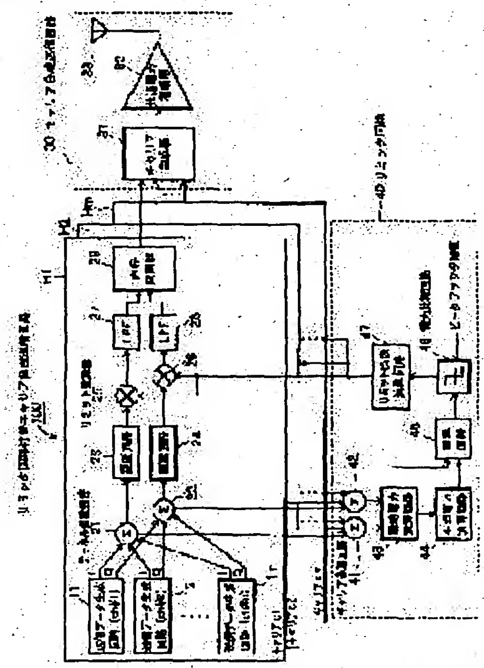
(54) COMBINATION CARRIER TRANSMISSION CIRCUIT WITH LIMITER CIRCUIT

(57)Abstract:

PROBLEM TO BE SOLVED: *To provide a combination carrier transmission circuit with a limiter circuit, which can reduce the bit error rate in a mobile station by transmitting data using a dynamic range of a power amplifier section efficiently.*

SOLUTION: *In the combination carrier transmission circuit 100 with a limiter circuit, when multiple carriers are transmitted from a base station, a limiter circuit 40 calculates the ratio of momentary power to average power of a signal obtained by multiplexing all of the carriers as a momentary peak factor, and then compares the momentary peak factor with a peak factor threshold value which is a reference value. Based on the comparison result, a limit factor calculation circuit 47 outputs a limit factor suitable for a degree to which clipping is required, and then limit multipliers 25, 26 perform clipping using the limit factor. Due to this mechanism, the bit error rate in the mobile station can be reduced using the dynamic range of the common power amplifier 3 without performing unnecessary clipping.*



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CLAIMS

[Claim(s)]
[Claim 1] In order to compound the signal conveyed by two or more carriers, to amplify within the predetermined amplification capacity of the power amplification section and to transmit simultaneously In the carrier composition sending circuit with a limiter circuit to which a limiter circuit outputs the limit coefficient for giving clipping respectively required for the instantaneous power which each carrier transmits before the amplification By the aforementioned limiter circuit's computing the ratio of the instantaneous power and mean power as an instant peak factor based on the signal which carried out multiplex [of all the carriers], and comparing the instant peak factor with a reference value The carrier composition sending circuit with a limiter circuit characterized by outputting the limit coefficient which suited the required grade of clipping.
[Claim 2] The 1st channel multiplex circuit which is characterized by providing the following and which is prepared corresponding to each of two or more carriers, multiplexes the in-phase signal of two or more channels conveyed by each carrier, and is outputted as a multiplexing in-phase signal, The 2nd channel multiplex circuit which is prepared corresponding to each carrier, multiplexes the rectangular signal of two or more aforementioned channels, and is outputted as a multiplexing rectangular cross signal, The limiter circuit which outputs the limit coefficient which directs required clipping which should be added to the instantaneous power of the 1st and 2nd channel multiplex circuit based on the instantaneous power which is an output of the 1st and 2nd channel multiplex circuit, The limit processing circuit which is prepared corresponding to each carrier and performs clipping to the instantaneous power of the 1st and 2nd multiplex circuit based on the limit coefficient from a limiter circuit, The quadrature modulation machine which is formed corresponding to each carrier and performs quadrature modulation with the multiplexing in-phase signal with which the limit processing circuit performed clipping, and a multiplexing rectangular cross signal, The carrier composition sending circuit with a limiter circuit which has the carrier composition machine which compounds the output from the quadrature modulation machine formed corresponding to each carrier, and the common power amplifier which carries out power amplification of the output of a carrier composition machine, and transmits from an antenna. The aforementioned limiter circuit is the 1st carrier multiplex circuit which multiplexes the output of the 1st channel multiplex circuit prepared corresponding to each carrier, respectively. The 2nd carrier multiplex circuit which multiplexes the output of the 2nd channel multiplex circuit prepared corresponding to each carrier, respectively. The limit coefficient output circuit which computes the limit coefficient given to each limit processing circuit corresponding to two or more carriers, and gives the computed limit coefficient to each limit processing circuit based on the instant output of the 1st and 2nd carrier multiplex circuit.
[Claim 3] The carrier composition sending circuit with a limiter circuit according to claim 2 characterized by providing the following. The aforementioned limit coefficient output circuit is an instantaneous-power arithmetic circuit which calculates the instant output of all carriers based on the instant output of the 1st and 2nd carrier multiplex circuit. The mean power arithmetic circuit which computes a section weighting average long enough to a chip rate based on the instant output of the 1st and 2nd carrier multiplex circuit. The division circuit which computes the ratio of an instantaneous power and mean power as an instant peak factor. A power comparator circuit [factor / instant peak / which was computed / reference value] and the limit coefficient arithmetic circuit which carries out the operation output of the limit coefficient from the comparison result of a power comparator circuit.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention compounds the signal especially conveyed by two or more carriers about a carrier composition sending circuit with a limiter circuit, and in order to amplify within the predetermined amplification capacity of the power amplification section and to transmit simultaneously, it relates to the carrier composition sending circuit with a limiter circuit to which a limiter circuit outputs the limit coefficient for giving clipping respectively *required for the instantaneous power which each carrier transmits before the amplification.*

[0002]
[Description of the Prior Art] In order that the impact given to the common power amplification section may pose a problem and may cope with it if the peak of transmitted power increases suddenly to mean power when many users get down and it occupies a circuit, it is made to suppress a peak power in the base station transmitter of the mobile communications system of the conventional DS-CDMA (Direct Sequence Code Division Multiple Access= direct diffusion code division multiple access). There is a carrier composition sending circuit with a limiter circuit shown in the "radio communication equipment" indicated by JP,11-313042,A and drawing 5 as such a conventional example. This radio communication equipment is indicating using a peak-power detection means to detect each peak power based on the sending signal of two or more carrier frequencies, and a synthetic means to compound an amendment peak-power amendment means and the sending signal of each carrier frequency for a peak power before power composition when the detected peak power exceeds a predetermined value. The carrier composition sending circuit 200 with a limiter circuit of drawing 5 is also constituted by the same thought. That is, in the carrier composition sending circuit 200 with a limiter circuit of drawing 5 , the same modulation circuits G1, G2-Gm are arranged corresponding to each of Carriers C1, C2-Cm.
[0003] *In each modulation circuit, the transmit* data generation circuits 111-11n are arranged corresponding to channel CH#1, CH#2 - CH#n. The quadrature component (it is henceforth described as Q component) of the QPSK modulating signal to which the in-phase component (it is henceforth described as I component) of the QPSK modulating signal to which the transmit data generation circuits 111-11n generated the channel multiplex circuit 121 was added, and, as for the channel multiplex circuit 122, the transmit data generation circuits 111-11n generated it is added. The addition result of the channel multiplex circuit 121,122 is handed over by a delay circuit 123,124 and the limiter circuit 140. In a limiter circuit 140, the instantaneous-power arithmetic circuit 143 power-izes the I/Q amplitude component in which the channel multiplex circuit 121,122 carried out multiplex by the sampling frequency of a chip rate, and computes an instantaneous power.
[0004] The mean power arithmetic circuit 144 computes a section weighting average long enough for the instantaneous power from the instantaneous-power arithmetic circuit 143 to a chip rate. The division circuit 145 computes an instantaneous power/mean power (instant peak factor) based on the result of an operation of the instantaneous-power arithmetic circuit 143 and the mean power arithmetic circuit 144. The power comparator circuit 146 compares the instant peak factor from the division circuit 145 with the peak factor threshold corresponding to the limit power threshold set up from a high order. The limit coefficient arithmetic circuit 147 judges whether the instantaneous power exceeded the limit power threshold from comparison with an instant peak factor and a peak factor threshold, and computes the limit coefficient which is a multiplication enumerated data for holding an instantaneous power to a limit power threshold.
[0005] On the other hand, a delay circuit 123,124 delays the next processing to the multiplex I/Q amplitude component which is the output of the channel multiplex circuit 121,122 by buffering until the limit coefficient arithmetic circuit 147 of a limiter circuit 140 computes a limit coefficient. The limit multiplier 125,126 carries out the multiplication of

the limit coefficient to the I/Q amplitude component for multiplex, respectively, and when required, it carries out clipping of the peak power, so that the topology of a multiplex I/Q amplitude component may not change. LPF (Low Pass Filter= low pass filter)127,128 filters the output of the limit multiplier 125,126, and band-limits it to desired occupancy bandwidth. The quadrature modulation machine 129 carries out quadrature modulation of the I/Q amplitude component from LPF127,128. The carrier composition machine 131 compounds two or more quadrature modulation signals from the quadrature modulation machine 129 about each carriers C1, C2-Cm. The common power amplifier 132 carries out power amplification of the result which the carrier composition machine 131 compounded, and transmits towards each mobile station from an antenna 133.

[0006] Operation of the carrier composition sending circuit 200 with a limiter circuit of drawing 5 is explained further. In this case, when single carrier transmission, all channels, etc. are assumed to be power and the transmit data of channel #n in sampling-time t is set to Di (n, t) and Dq (n, t), the multiplex I/Q amplitude component Ai of channel #1 to channel #n (t) and Aq (t) are a lower formula [0007].

[Equation 1]

$$Ai(t)=\sum_{k=1}^{n} Di(k,t) \qquad Aq(t)=\sum_{k=1}^{n} Dq(k,t) \qquad 1\leq k\leq n \qquad \cdots (1\cdot 1)$$

[0008] ** -- it is shown like When KONSUTERESHON when there is no limiter circuit 140 of drawing 5 is seen, it turns out that the I/Q amplitude component exceeding the limit power threshold shown with the circle of drawing 6 (a) exists at random. In this case, drawing 6 (b) shows the relation of the instantaneous power to the sampling time. In an above-mentioned case, an instantaneous power Pint (t) is a lower formula. [0009]

[Equation 2]

$$Pint(t)=\sqrt{(Ai(t)^2+Aq(t)^2)} \qquad \cdots (1\cdot 2)$$

[0010] ** -- it is shown like Moreover, since it is the value which equalized the instantaneous power to the chip rate in the section T long enough in order to ease the influence of phasing, mean power Pavg (t) is a lower formula [0011].

[Equation 3]

$$Pavg(t)=(1/T)\sum_{k=t}^{t-T} Pint(k) \qquad \cdots (1\cdot 3)$$

[0012] ** -- it is shown like Therefore, the instant peak factor PF in sampling-time t (t) is called for from mean power Pavg (t) and an instantaneous power Pint (t). The allowed value of an instant peak factor is a scale which determines the performance of common power amplifier, and efficient-ization of it is attained as a low. In this case, the instant peak factor PF (t) is shown like a lower formula.

[0013]

PF(t) =10 -- log [Pint(t)/Pavg (t)] [dB] .. (1-4)

[0014] The limit power threshold Plimit (t) is computed by the peak factor threshold PFthrsh [dB] usually controlled by the high order layer. That is, it is shown like a lower formula.

[0015]

Plimit(t) =Pavg(t) x10PFthrsh/10 .. (1-5)

[0016] The limit level coefficient C oef (t) is determined by the size relation between an instantaneous power and a limit power threshold. That is, it is shown like a lower formula.

[0017]

Coef(t) =1 Pint(t) <=Plimit (t) Coef(t) =Plimit(t)/Pint (t) Pint(t) >Plimit .. (1-6)

[0018] And finally clipping of the instantaneous power beyond the limit power threshold is carried out to a limit power threshold by multiplication with a limit level coefficient. In this case, if the multiplex I/Q amplitude component after limit processing is made into Ai' (t) and Aq' (t), it can be shown like a lower formula.

[0019]

Ai'(t) =Ai(t) xCoef(t) Aq' (t) =Aq(t) xCoef (t) .. (1-7)

[0020] Amplitude limiting of the multiplex I/Q amplitude component which is KONSUTERESHON with the limit circuit of drawing 7 (a), and exceeded the limit power threshold so that it might understand is carried out in the direction of a zero, without carrying out phase rotation. Moreover, if a limit power threshold becomes small so that the relation of the instantaneous power to the sampling time of drawing 7 (b) may show, the generating frequency of the

instantaneous power by which clipping is carried out so much will increase.

[0021]

[Problem(s) to be Solved by the Invention] In the carrier composition sending circuit with a limiter circuit of the conventional base station transmitter mentioned above, although it was possible to have controlled an instant peak factor independently for every carrier, control of the instant peak factor about the radio frequency signal of two or more carrier composition had not been carried out. Therefore, it is necessary to set up limit level beforehand low from possible default value, and there is a problem that the dynamic range of latter power amplifier is effectively unutilizable, supposing the increment of the instant peak factor by carrier composition. Thus, since the bit error to transmit data is made to increase when the amplitude level which carries out clipping increases as a result, the property of the bit error rate of a mobile station receive section is made to deteriorate.

[0022] This invention is made that the above-mentioned problem should be solved, and is a thing. at the time of multi-carrier transmission of a base station By computing the ratio of the instantaneous power and mean power as an instant peak factor, and comparing the instant peak factor with a reference value based on the signal which compounded all carriers The limit coefficient which suited the required grade of clipping can be outputted, the dynamic range of the common power amplification section can be utilized effectively, and efficient-ization can be attained. It aims at offering the carrier composition sending circuit with a limiter circuit which can aim at improvement in an adjacent-channel disclosure power property, and improvement in a property of the bit error rate in a mobile station through optimization of limit level.

[0023]

[Means for Solving the Problem] In order to solve the technical problem mentioned above, this invention In order to compound the signal conveyed by two or more carriers, to amplify within the predetermined amplification capacity of the power amplification section and to transmit simultaneously In the carrier composition sending circuit with a limiter circuit to which a limiter circuit outputs the limit coefficient for giving clipping respectively required for the instantaneous power which each carrier transmits before the amplification The aforementioned limiter circuit outputs the limit coefficient which suited the required grade of clipping by computing the ratio of the instantaneous power and mean power as an instant peak factor, and comparing the instant peak factor with a reference value based on the signal which carried out multiplex [of all the carriers].

[0024] According to such composition, based on the signal which carried out multiplex [of all the carriers], a limiter circuit computes the ratio of the instantaneous power and mean power as an instant peak factor, and outputs the limit coefficient which suited the required grade of clipping by the result which compared the instant peak factor with the reference value. And since the carrier composition sending circuit with a limiter circuit performs clipping required for the instantaneous power in each carrier based on this limit coefficient, the sending signal after compounding each carrier after performing clipping is in the state of using the predetermined amplification capacity of the power amplification section for the maximum effective.

[0025] And in order to compound the signal conveyed by two or more carriers C1, C2-Cm with the carrier composition vessel 31 with the gestalt of implementation of this invention and to transmit simultaneously within the predetermined amplification capacity of power amplifier 32 In the carrier composition sending circuit 100 with a limiter circuit to which a limiter circuit 40 outputs the limit coefficient which gives clipping respectively required for the instantaneous power which each carriers C1, C2-Cm transmit By the aforementioned limiter circuit's 40 computing the ratio of the instantaneous power and mean power as an instant peak factor based on the signal which carried out multiplex [of all the carriers C1, C2-Cm], and comparing the instant peak factor with a reference value The limit coefficient which suited the required grade of clipping is outputted. Therefore, the carrier composition sending circuit 100 with a limiter circuit Since the limit multipliers 25 and 26 perform required clipping to the instantaneous power of each carrier C1, C2-Cm before performing power amplification by the common power amplifier 32 based on this limit coefficient After performing clipping, the sending signal after the carrier composition machine 31 compounds each carrier is in the state of using the predetermined amplification capacity of the common power amplification section 32 for the maximum effective.

[0026] Moreover, the 1st channel multiplex circuit which this invention is prepared corresponding to each of two or more carriers, multiplexes the in-phase signal of two or more channels conveyed by each carrier, and is outputted as a multiplexing in-phase signal, The 2nd channel multiplex circuit which is prepared corresponding to each carrier, multiplexes the rectangular signal of two or more aforementioned channels, and is outputted as a multiplexing rectangular cross signal, The limiter circuit which outputs the limit coefficient which directs required clipping which should be added to the instantaneous power of the 1st and 2nd channel multiplex circuit based on the instantaneous power which is an output of the 1st and 2nd channel multiplex circuit, The limit processing circuit which is prepared corresponding to each carrier and performs clipping to the instantaneous power of the 1st and 2nd multiplex circuit

based on the limit coefficient from a limiter circuit, The quadrature modulation machine which is formed corresponding to each carrier and performs quadrature modulation with the multiplexing in-phase signal with which the limit processing circuit performed clipping, and a multiplexing rectangular cross signal, In the carrier composition sending circuit with a limiter circuit which has the carrier composition machine which compounds the output from the quadrature modulation machine formed corresponding to each carrier, and the common power amplifier which carries out power amplification of the output of a carrier composition machine, and transmits from an antenna The 1st carrier multiplex circuit which multiplexes the output of the 1st channel multiplex circuit in which the aforementioned limiter circuit was prepared corresponding to each carrier, respectively, The 2nd carrier multiplex circuit which multiplexes the output of the 2nd channel multiplex circuit prepared corresponding to each carrier, respectively, Based on the instant output of the 1st and 2nd carrier multiplex circuit, the limit coefficient given to each limit processing circuit corresponding to two or more carriers is computed, and it has the limit coefficient output circuit which gives the computed limit coefficient to each limit processing circuit.

[0027] In this invention furthermore, the aforementioned limit coefficient output circuit The instantaneous-power arithmetic circuit which calculates the instant output of all carriers based on the instant output of the 1st and 2nd carrier multiplex circuit, The mean power arithmetic circuit which computes a section weighting average long enough to a chip rate based on the instant output of the 1st and 2nd carrier multiplex circuit, It has the division circuit which computes the ratio of an instantaneous power and mean power as an instant peak factor, a power comparator circuit [factor / instant peak / which was computed / reference value], and the limit coefficient arithmetic circuit which carries out the operation output of the limit coefficient from the comparison result of a power comparator circuit.

[0028]

[Embodiments of the Invention] Hereafter, the gestalt of implementation of this invention is explained based on an accompanying drawing. The circuit block diagram in which drawing 1 shows the gestalt of operation of the carrier composition sending circuit with a limiter circuit of this invention, drawing 2 , or drawing 4 is drawing for explaining operation of the carrier composition sending circuit with a limiter circuit of drawing 1 . The carrier composition sending circuit 100 with a limiter circuit of drawing 1 Two or more modulation circuits H1, H2-Hm which correspond to two or more carriers C1, C2-Cm, respectively for the purpose of using it for the base station transmitter of the mobile communications system of DS-CDMA or MC-CDMA etc., It consists of a limiter circuit 40 which gives a limit coefficient to each modulation circuit H1, H2-Hm, and a carrier composition sending circuit 30 which compounds the quadrature modulation output from each modulation circuit H1, H2-Hm, and transmits from an antenna.

[0029] Although the carrier composition sending circuit 100 with a limiter circuit of drawing 1 is not necessarily limited to this, it shall consist of form that modulation circuits H1, H2-Hm are the same. For example, each of modulation circuits H1, H2-Hm has the transmit data generation circuits 11-1n which generate the transmit data which is the QPSK modulating signal which consists of an in-phase component (I component) and a quadrature component (Q component) corresponding to channel ch#1, ch#2 - ch#n. Q component of each channel to which I component of each channel to which the transmit data generation circuits 11-1n generated the channel multiplex circuit 21 was added, and, as for the channel multiplex circuit 22, the transmit data generation circuits 11-1n generated it is added. The output of the channel multiplex circuits 21 and 22 is given to the carrier multiplex circuits 41 and 42 of a limiter circuit 40, respectively while it is given to delay circuits 23 and 24.

[0030] In a limiter circuit 40, the carrier multiplex circuit 41 adds I component which is the output of each channel multiplex circuit 21 of the modulation circuits H1, H2-Hm about the effective carriers C1, C2-Cm (multiplex). Similarly, the carrier multiplex circuit 42 adds Q component which is the output of each channel multiplex circuit 22 of the modulation circuits H1, H2-Hm about the effective carriers C1, C2-Cm. The instantaneous-power arithmetic circuit 43 power-izes the I/Q amplitude component in which the carrier multiplex circuits 41 and 42 carried out multiplex, respectively by the sampling frequency of a chip rate, and computes an instantaneous power. The mean power arithmetic circuit 44 computes a section weighting average long enough for the instantaneous power from the instantaneous-power arithmetic circuit 43 to a chip rate.

[0031] The division circuit 45 computes an instantaneous power/mean power (instant peak factor) based on the result of an operation of the instantaneous-power arithmetic circuit 43 and the mean power arithmetic circuit 44. The power comparator circuit 46 compares with the instant peak factor from the division circuit 45, and the peak factor threshold (computed from a limit power threshold) set up from a high order. The limit coefficient arithmetic circuit 47 judges whether the instantaneous power exceeded the limit power threshold from comparison with the instant peak factor and peak factor threshold by the power comparator circuit 46 (after-mentioned), and computes the limit coefficient which is a multiplication enumerated data for holding an instantaneous power to a limit power threshold.

[0032] On the other hand, in modulation circuits H1, H2-Hm, delay circuits 23 and 24 are delaying the next processing to the multiplex I/Q amplitude component which is the output of the channel multiplex circuits 21 and 22 by buffering

until the limit coefficient arithmetic circuit 47 computes a limit coefficient. To the I/Q amplitude component for multiplex, the limit multipliers 25 and 26 carry out the multiplication of the limit coefficient from the limit coefficient arithmetic circuit 47, respectively, and perform required clipping to a peak power so that the topology of a multiplex I/Q amplitude component may not change. LPF (Low Pass Filter= low pass filter) 27 and 28 filters the output of the limit multipliers 25 and 26, and band-limits it to desired occupancy bandwidth. The quadrature modulation machine 29 carries out quadrature modulation of the I/Q amplitude component from LPF 27 and 28.

[0033] The carrier composition machine 31 of the carrier composition sending circuit 30 compounds two or more quadrature modulation outputs from each quadrature modulation machine 29 about each carriers C1, C2-Cm. The common power amplifier 32 carries out power amplification of the result to which the carrier composition machine 31 compounded two or more quadrature modulation outputs, and transmits towards each mobile station from an antenna 33. Thus, in the carrier composition sending circuit 100 with a limiter circuit of drawing 1, a limiter circuit 40 compounds all the carriers C1, C2-Cm, and control about the instant peak factor in each carrier is performed based on the result which checked the whole. Therefore, since it does not carry out controlling an instant peak factor independently to each of Carriers C1, C2-Cm like before, it is not necessary to set up a limit power threshold lower than default value, and the dynamic range of the latter common power amplifier 32 can be effectively utilized beforehand supposing the increment of the instant peak factor by carrier composition.

[0034] Operation of the above-mentioned multi-carrier composition sending circuit 100 is explained in more detail with reference to drawing 2 or drawing 4. Here, in order to simplify explanation, it is assumed that it is 2 carrier transmission. When the n channel transmit data of sampling-time t in a carrier C1 is set to D1i (n, t) and D1q (n, t), multiplex I/Q amplitude component A1of channel #1 to channel #n i (t) and A1q (t) are a lower formula [0035].

[Equation 4]

$$A1i(t)=\sum_{k=1}^{n} D1i(k,t) \qquad A1q(t)=\sum_{k=1}^{n} D1q(k,t) \qquad 1\leqq k\leqq n \qquad \cdots (2\cdot 1)$$

[0036] ** -- it is shown like Moreover, multiplex I/Q amplitude component A2after channel multiplex [of a carrier C2] i (t) and A2q (t) are a lower formula [0037].

[Equation 5]

$$A2i(t)=\sum_{k=1}^{n} D2i(k,t) \qquad A2q(t)=\sum_{k=1}^{n} D2q(k,t) \qquad 1\leqq k\leqq n \qquad \cdots (2\cdot 2)$$

[0038] ** -- it is shown like The instantaneous power Pint1 of each carriers C1 and C2 (t) and Pint2 (t) are a lower formula [0039].

[Equation 6]

$$Pint1(t)=\sqrt{(A1i(t)^2+A1q(t)^2)}$$

$$Pint2(t)=\sqrt{(A2i(t)^2+A2q(t)^2)} \qquad \cdots (2\cdot 3)$$

[0040] ** -- it is shown like In the carrier composition sending circuit 100 with a limiter circuit of drawing 1, when multi-carriers are carriers C1 and C2, and there shall be no limiter circuit 40, the relation of the instantaneous power to the sampling time of a carrier C1 and a carrier C2 is shown like drawing 2 (a) and drawing 2 (b), respectively. In addition, since an instantaneous power changes with effective numbers of channels and transmitted power values of each channel, it is mean power Pavg1 (t). It reaches. Pavg2 (t) It becomes each carrier independence. Instantaneous power after carrier multiplex Pint_comb (t) Instant peak factor PFcomb (t) Limit power threshold Plimit_comb (t) The calculation method is the same also in the conventional limiter circuit, and an instantaneous power is changed as shown in drawing 2 (c). In addition, the value of the instant peak factor after carrier multiplex becomes equivalent to the value of the instant peak factor in the radio frequency signal of the common amplifier preceding paragraph, and is a peak factor threshold. PFthrsh [dB] Suppression of a peak power is attained. It will be [0041] if a formula shows.

Pint_comb(t) =Pint1(t)+Pint2 (t) .. (2-4)

[Equation 7]

$$Pavg\_comb(t) = (1/T) \sum_{k=t}^{t-T} Pint\_comb(k) \quad \cdots (2 \cdot 5)$$

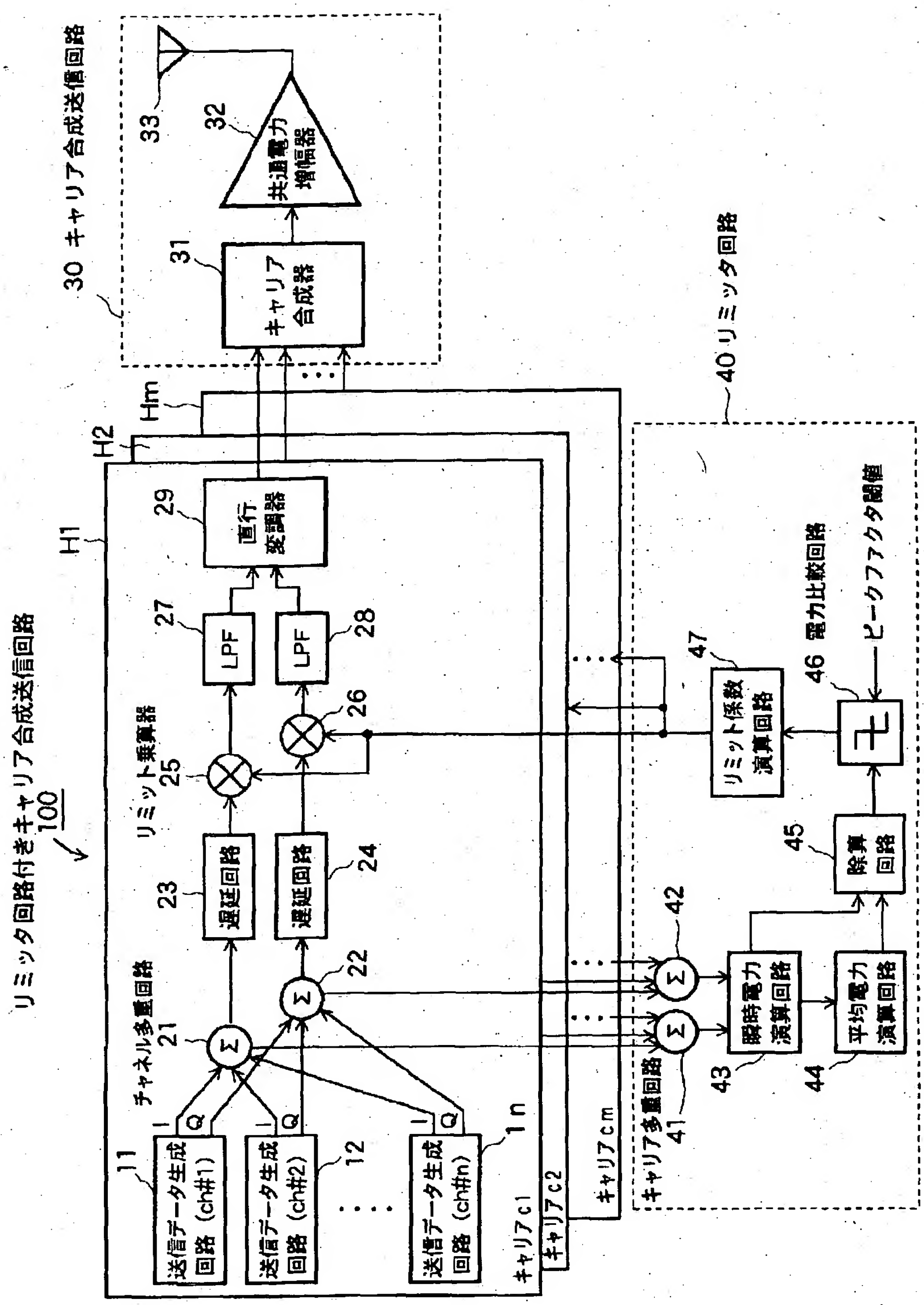
PFcomb(t) =10 -- log [Pint_comb(t)/Pavg_comb (t)] [dB] .. (2-6)
Plimit_comb(t) (t) =Pavg_comb(t) (t) x10PFthrsh/10 .. (2-7)
[0042] It becomes. Therefore, it is a limit coefficient common to all carriers by the size relation between the instantaneous power after carrier multiplex, and a limit power threshold. Coef_comb (t) It is determined. Namely, limit coefficient Coef_comb (t) It is shown like a lower formula.
[0043]
Coef_comb(t) =1 However, Pint_comb(t) <=Plimit_comb(t) Coef_comb(t) =Plimit_comb(t)/Pint_comb (t) However, Pint_comb(t) >Plimit_comb (t) .. (1-6)
[0044] If the multiplex I/Q amplitude component after such limit processing is made into A1i' (t), A1q' (t) and A2i' (t), and A2q' (t), it can be shown like a lower formula.
[0045]
A1i'(t) =A1i(t) xCoef_comb(t) A1q' (t) =A1q(t) xCoef_comb (t) A2i'(t) =A2i(t) xCoef_comb(t) A2q' (t) =A2q(t) xCoef_comb (t) .. (2-9)
[0046] The carrier composition sending circuit 200 with a limiter circuit using the limiter circuit corresponding to the here conventional single carrier, If the carrier composition sending circuit 100 with a limiter circuit using the limiter circuit corresponding to the multi-carrier of this invention is compared Although it is controllable by the peak factor threshold (a limit power threshold is determined) set as carrier independence by the high order layer like drawing 3 (a) and drawing 3 (b) in the conventional carrier composition sending circuit 200 with a limiter circuit At the time of two or more carrier composition with a carrier composition machine, the instantaneous power is controlled to be restored to low peak value from an actually usable limit power threshold to be shown in drawing 3 (c) (that is, controlled lower than the amplification capacity of common power amplifier). This will add amplitude limiting even to the I/Q component which does not need clipping, and brings a result which inserts the bit which was mistaken to all transmit data.
[0047] Unlike the above-mentioned case, according to the carrier composition sending circuit 100 with a limiter circuit of this invention, as shown in drawing 4 (c), the actually usable limit power threshold is made usable to the limit (that is, the amplification capacity of common power amplifier is fully used). Although there is an instantaneous power exceeding a limit power threshold as shown by drawing 3 (a) and drawing 3 (b) if it sees from a viewpoint of carrier independence as it is shown in drawing 4 (a) and drawing 4 (b), if it puts in another way Since clipping of the instantaneous power of each carrier is carried out only when exceeding two or more usable limit power thresholds after carrier (multi-carrier) multiplex While using the actually usable limit power threshold to the limit, amplitude limiting is not added to the I/Q component which does not need clipping. In addition, in the above-mentioned carrier composition sending circuit 100 with a limiter circuit, if LPF 27 and 28 is constituted from the analog section after D/A conversion, the great gate number which uses an FIR filter is not needed, but curtailment of a hard scale is possible.
[0048]
[Effect of the Invention] The carrier composition sending circuit with a limiter circuit of this invention Since it is constituted as explained above, at the time of multi-carrier transmission of base stations, such as MC-CDMA By computing the ratio of the instantaneous power and mean power as an instant peak factor, and comparing the instant peak factor with the peak factor threshold which is a reference value based on the signal which carried out multiplex [of all the carriers] The limit coefficient which suited the required grade of clipping can be outputted, the dynamic range of the common power amplification section can be utilized effectively, and efficient-ization can be attained. Moreover, improvement in an adjacent-channel disclosure power property and improvement in a property of the bit error rate in a mobile station can be aimed at through optimization of such a limit coefficient.

[Translation done.]

* NOTICES *

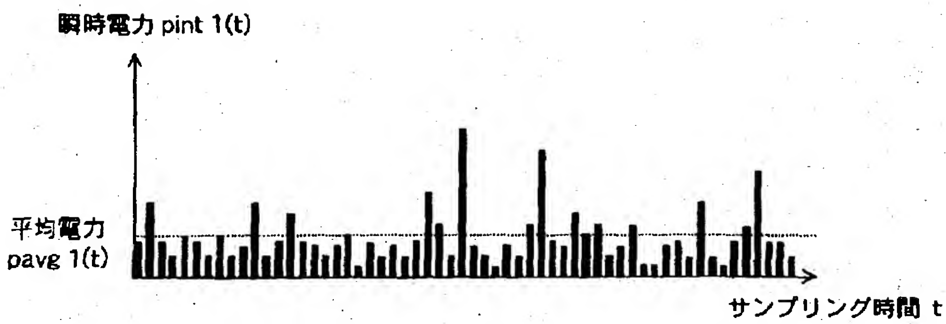
DRAWINGS

[Drawing 1]

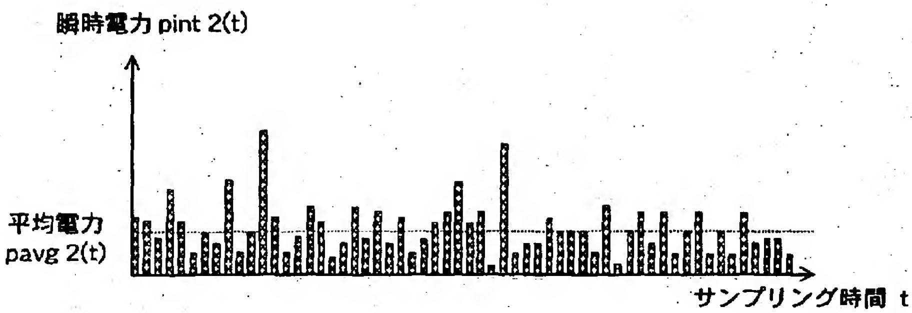

リミッタ回路付きキャリア合成送信回路
100
30 キャリア合成送信回路
31 キャリア合成器
32 共通電力増幅器
33
H1
H2
Hm
29 直行変調器
27 LPF
28 LPF
25 リミット乗算器
26
23 遅延回路
24 遅延回路
21 チャネル多重回路
22
Σ
11 送信データ生成回路(ch#1)
12 送信データ生成回路(ch#2)
1n 送信データ生成回路(ch#n)
I
Q
キャリアc1
キャリアc2
キャリアcm
40 リミッタ回路
41 キャリア多重回路
42
43 瞬時電力演算回路
44 平均電力演算回路
45 除算回路
46 電力比較回路
ピークファクタ閾値
47 リミット係数演算回路

[Drawing 2]

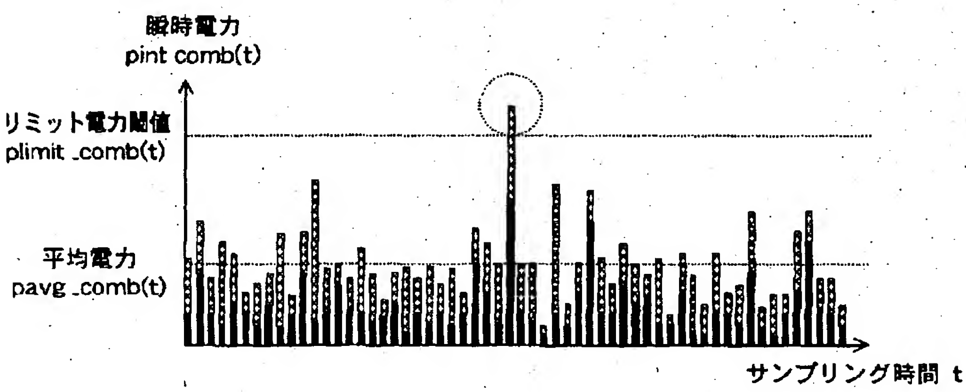
(a)



(b)

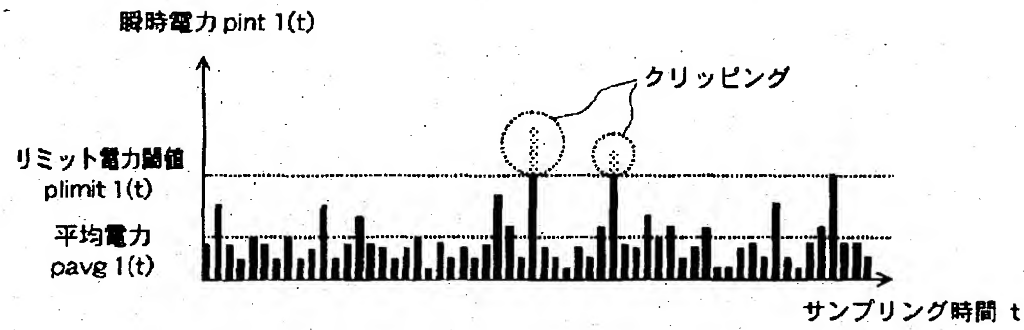


(c)

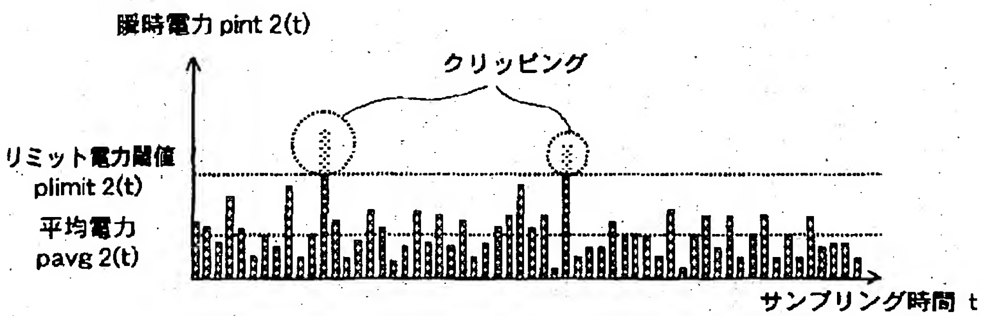


[Drawing 3]

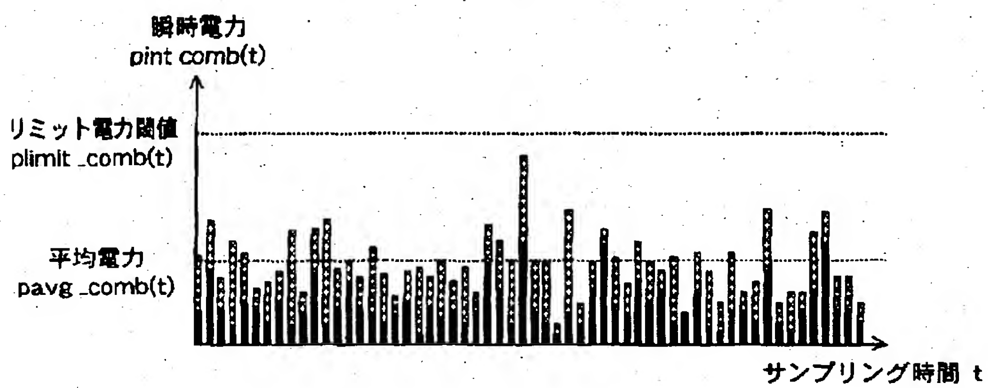
(a)



(b)

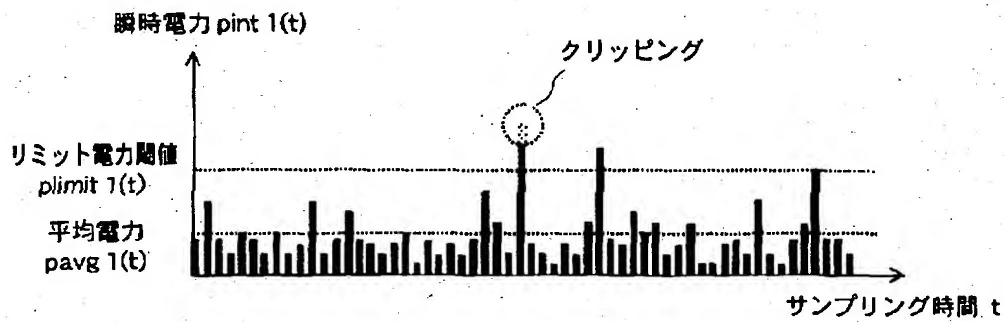


(c)

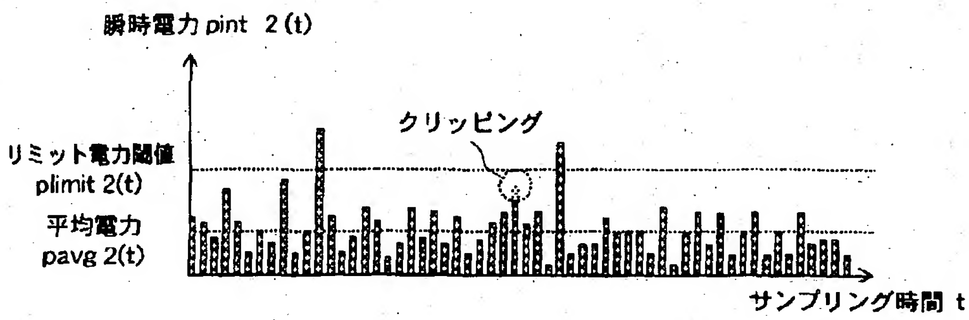


[Drawing 4]

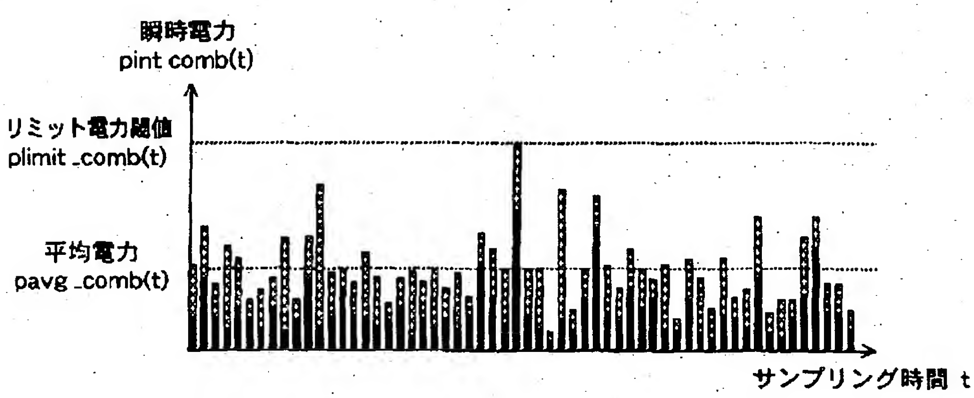
(a)



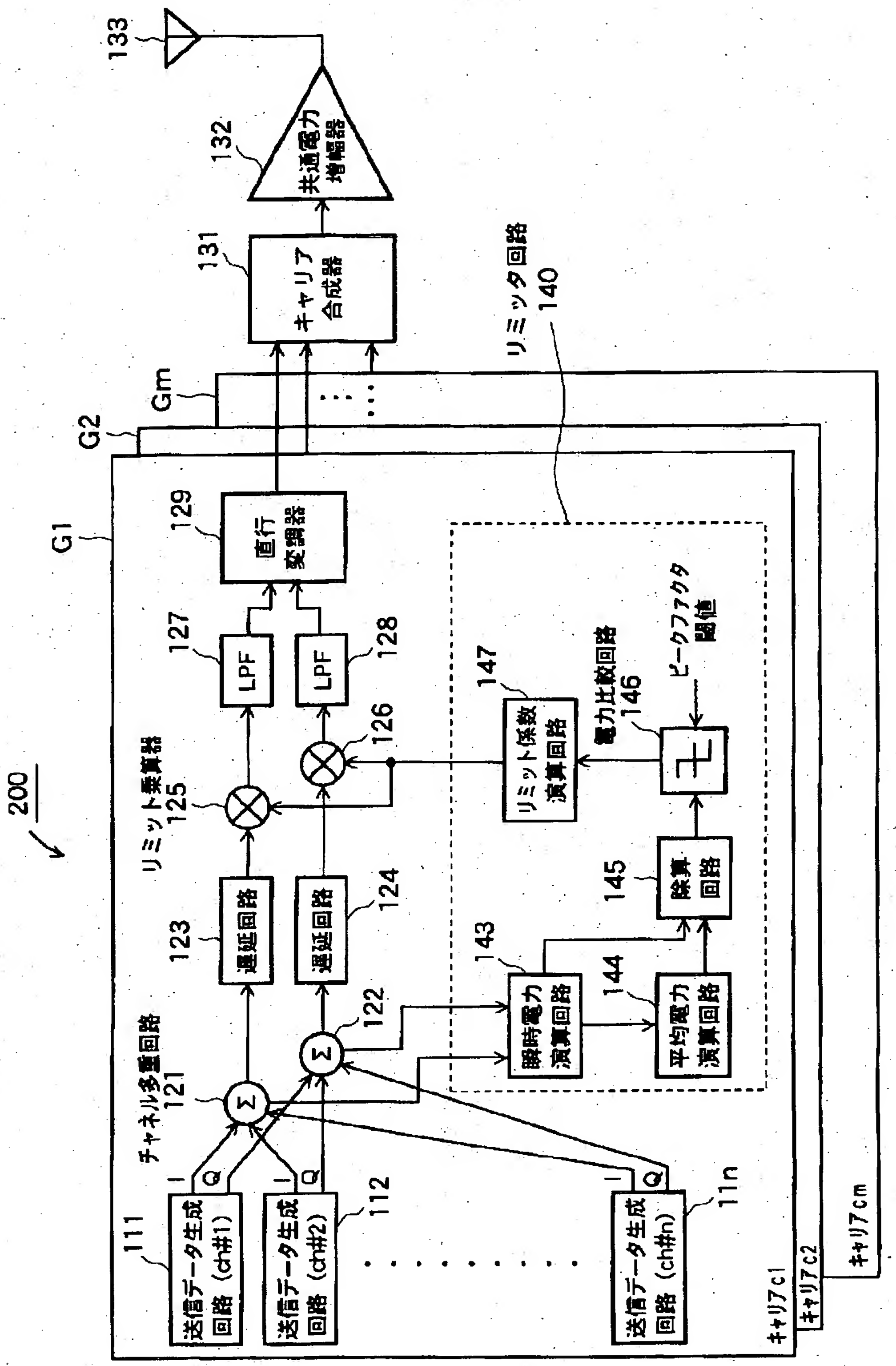
(b)



(c)

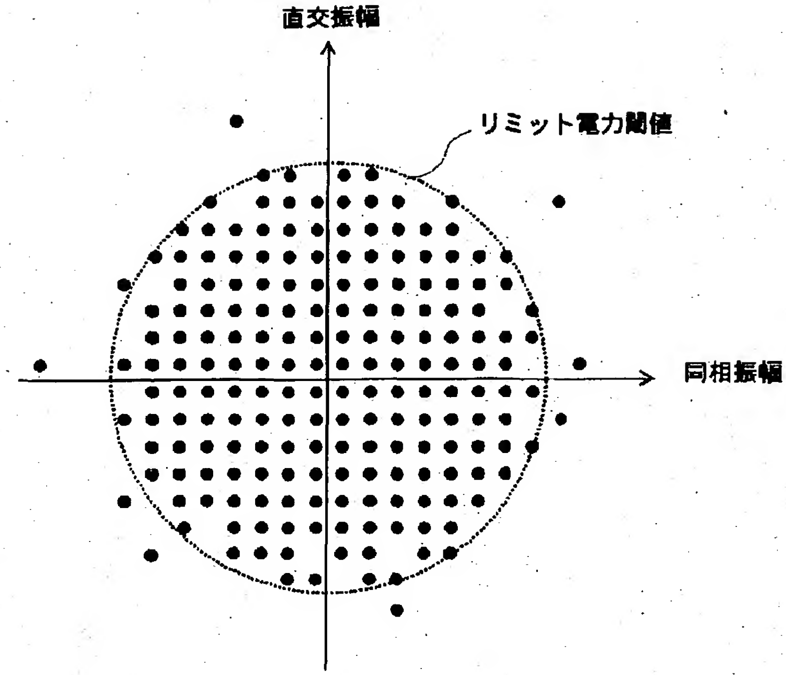


[Drawing 5]

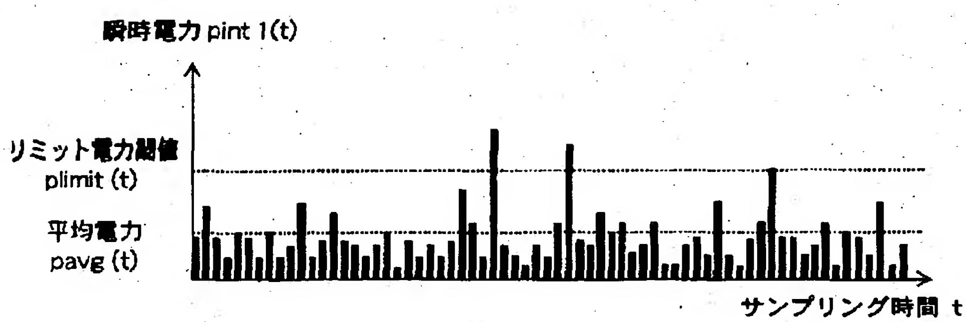

200
133
132
共通電力増幅器
131
キャリア合成器
Gm
G2
G1
129
直行変調器
127
LPF
128
LPF
126
125
リミット乗算器
123
遅延回路
124
遅延回路
121
チャネル多重回路
122
リミッタ回路
140
147
リミット係数演算回路
電力比較回路
146
ピークファクタ閾値
145
除算回路
143
瞬時電力演算回路
144
平均電力演算回路
I
Q
111
送信データ生成回路（ch#1）
112
送信データ生成回路（ch#2）
11n
送信データ生成回路（ch#n）
キャリアc1
キャリアc2
キャリアcm

[Drawing 6]

(a)

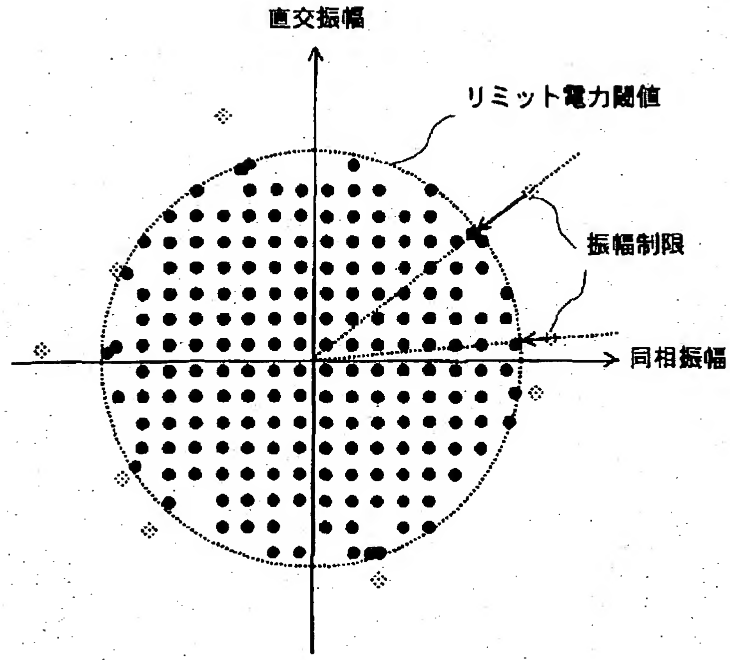

直交振幅
リミット電力閾値
同相振幅

(b)

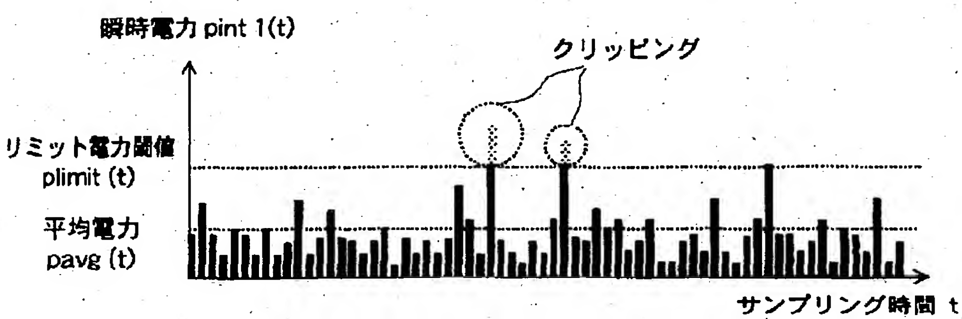

瞬時電力 pint 1(t)
リミット電力閾値
plimit (t)
平均電力
pavg (t)
サンプリング時間 t

[Drawing 7]

(a)



(b)



[Translation done.]